

# ORGANIC CHEMISTRY

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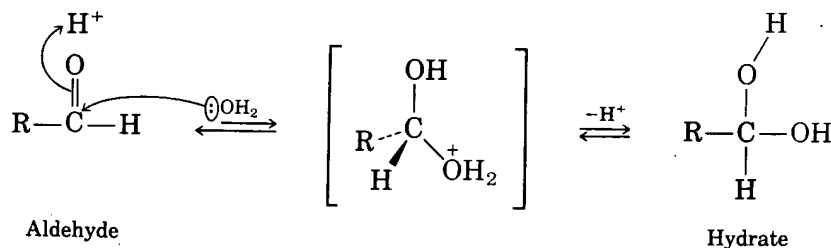
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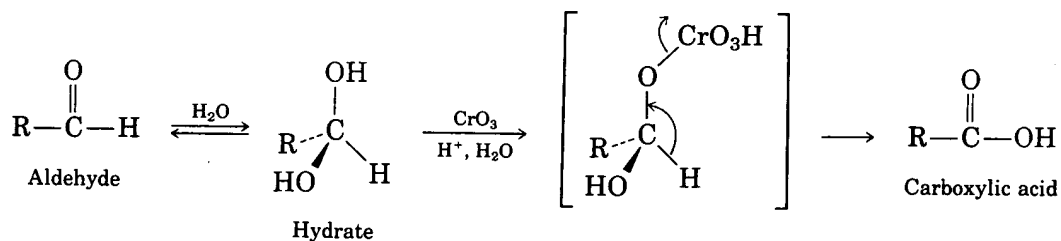
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A shiny mirror of metallic silver is deposited on the walls of the flask during a Tollens oxidation; observation of such a mirror forms the basis of an old qualitative test for the presence of an aldehyde functional group in a molecule of unknown structure. A small sample of the unknown is dissolved in ethanol in a test tube, and a few drops of the Tollens reagent are added. If the test tube becomes silvery, the unknown is presumed to be an aldehyde.

Aldehyde oxidations are thought to occur through intermediate 1,1-diols or hydrates, which are formed by nucleophilic addition of water to the carbonyl group. Hydrate formation is reversible—the hydrate can eliminate water to re-form aldehyde—and the equilibrium position of the reaction usually favors the aldehyde:



Once formed, and even though present in small amounts, the hydrate reacts like any normal primary or secondary alcohol and is oxidized to a carbonyl compound (Section 20.10).



Ketones are inert to most common oxidizing agents but undergo a slow cleavage reaction when treated with hot alkaline  $\text{KMnO}_4$ . The carbon-carbon bond next to the carbonyl group is broken and carboxylic acid fragments are produced. The reaction is only useful for symmetrical ketones such as cyclohexanone, however, since product mixtures are formed from unsymmetrical ketones.

